Three

DEATH:

Defining the Final Frontier

The Midas Rex whirlwind bone saw, rotating at a constant 73,000 rpm, was deftly held by the surgeon like a brush in the hand of an artist. A loud whirring noise, similar to that of a dentist's drill, filled the sterile air of the operating room.[2]

Brain surgery was about to begin.

Thirty-five-year-old Pam Reynolds was being operated on for a giant basilar artery aneurysm. A weakness in the wall of the large artery at the base of her brain had caused it to balloon out much like a bubble on the side of a defective automobile tire. Rupture of the aneurysm would be immediately fatal.

The size and location of the aneurysm, however, precluded its safe removal using the standard neurosurgical techniques available to Pam in her hometown of Atlanta. She had been referred to Dr. Robert Spetzler, Director of Barrow Neurological Institute in Phoenix, Arizona. Spetzler had pioneered a daring surgical procedure known as hypothermic cardiac arrest, which would allow Pam's aneurysm to be excised with a reasonable chance of success. This operation, nicknamed "standstill" by the doctors who perform it, would require that her body temperature be lowered to 60 degrees, her heartbeat and breathing stopped, her brain waves flattened, and the blood drained from her head. In everyday terms she would be dead. But in the hands of skilled physicians she was not. Or was she?

The question of when death occurs is raised frequently in discussions of the near-death experience. To understand scientifically the relationship of death to the near-death experience, we must first measure as precisely as possible the physiologic state of the body during the NDE. Unfortunately, most popular NDE accounts come with little or no verification of the purported medical crisis or of physiologic parameters such as brain-wave activity, blood pressure, cardiac rhythm, et cetera. The whole episode frequently rests on self-report alone. In The Atlanta Study, however,

medical documentation of the events surrounding the near-death experience was obtained whenever possible. In Pam's case, this documentation *far exceeds* any recorded before and provides us with our most complete scientific glimpse yet into the near-death experience.

Pam had been awake when brought into the operating room at 7:15 that August morning in 1991. She remembers the IVs, "so many of them," followed by "a loss of time" as the intravenous penthathol worked its calming magic on her.

According to Spetzler's surgical report, her body was lifted onto the operating table and her arms and legs securely tied down. Her eyes were lubricated to prevent drying and then taped shut. An endotracheal tube was skillfully guided through her mouth into her windpipe, and general anesthesia was begun.

For the next hour and twenty-five minutes, Pam's unconscious body was instrumented with the most advanced technology, some of which had been specifically designed for hypothermic arrest.

A two-inch-long plastic tube was slipped into the artery in her wrist to continuously monitor her blood pressure. A three-foot long Swan Ganz catheter, resembling an elongated piece of spaghetti, was threaded through the jugular vein of her neck into the artery in her lung to measure pulmonary pressures and blood flow from her heart. Cardiac monitoring leads were attached to follow heart rate and rhythm, and an oximeter was taped to her index finger to measure oxygen levels in her blood.

Precise documentation of body temperature would be crucial. Urinary temperature would be measured by a special thermister on the tip of a Foley catheter placed in Pam's bladder. Core body temperature from the innermost part of her body would be monitored with another thermister placed deeply into her esophagus. The temperature of her brain would be registered through a thin wire embedded in its surface.

Standard EEG electrodes taped to her head would record cerebral cortical brain activity. The auditory nerve center located in the brain stem would be tested repeatedly using 100-decibel clicks emitted from small, molded speakers inserted into her ears. In response to these clicks, sharp spikes on the electrogram (i.e., evoked potentials) would assure the surgical team that the brain stem was intact.

Four separate sites were prepped for surgery: the right side of Pam's head for the craniotomy, the chest for possible open-heart surgery, and both

groins for femoral artery and vein access for cardiopulmonary bypass. Adhesive defibrillator pads were stuck to her chest in case her heart needed to be shocked back to life.

Finally, Pam's head was turned to a full left lateral position and secured in a three-point-pin head holder.

By 8:40 A.M., Pam's entire body except for her head and groin had been blanketed with sterile drapes. Over 20 doctors, nurses, and technicians had scrubbed in (see Figure 1).

Surrounding Pam's head was the neurosurgical team, including Spetzler, who sat in a specialized chair controlled by foot pedals, leaving both hands free to operate. To the right of her legs stood the cardiac surgical team. At her feet sat the heart-pump technicians with their giant chrome-headed pump oxygenator and cardiopulmonary bypass equipment. And to her left were the neuroanesthesiologists, who were monitoring her vital signs and brain function. Perfect coordination among these four medical teams would be critical if the aneurysm were to be successfully removed and Pam retrieved from her journey to the edge of death.

Spetzler began the surgery by carefully marking the incision lines on Pam's shaved head and quickly opening the scalp with a curved surgical blade. The scalp flap was folded back, exposing a glistening gray skull. A surgical nurse handed Spetzler the pneumatically-powered Midas Rex, attached by a long green hose to compressed air tanks in the corner of the room. A loud buzzing noise then filled the OR as the powerful, thumb-sized motor hidden in the brass head of the bone saw revved up. The cutting tool began to carve out a large section of Pam's skull.

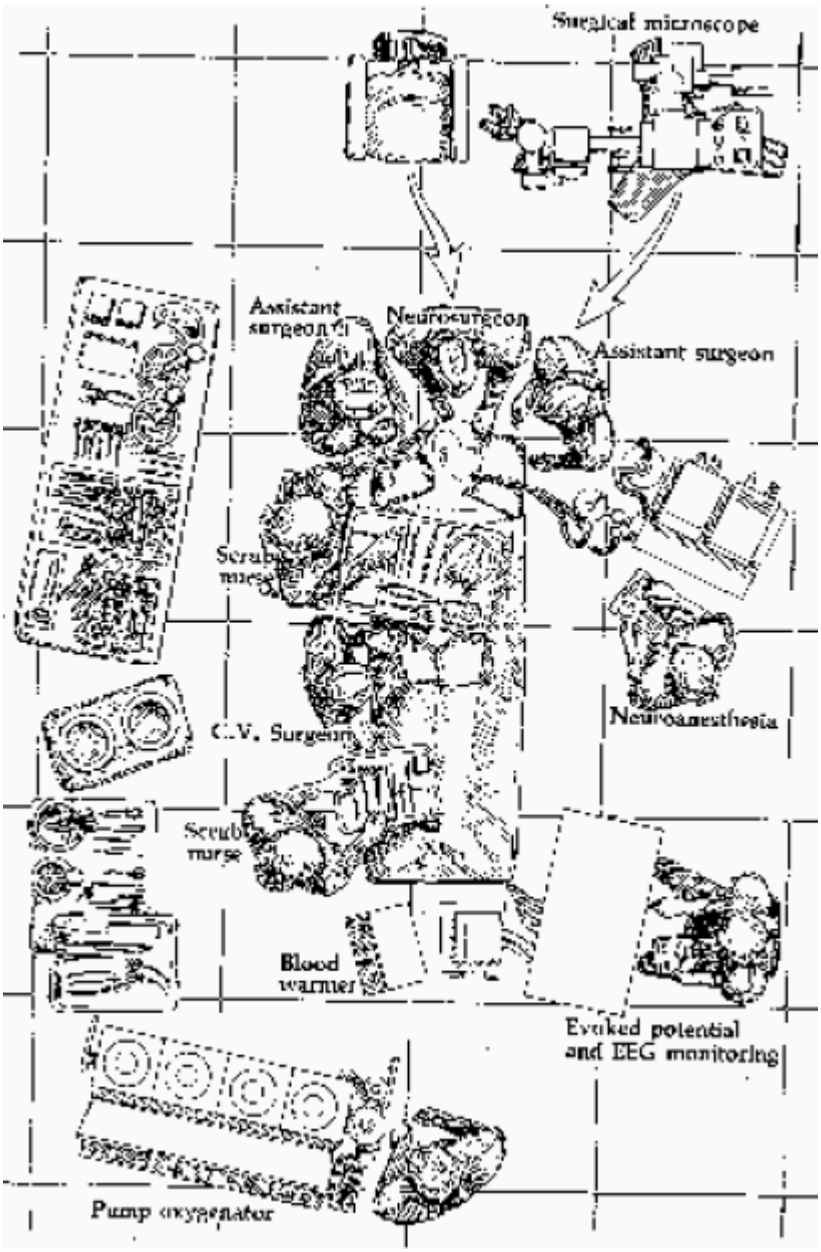

Figure 1: *Diagram of the operating room at Barrow Neurological Institute from a perspective similar to Pam's out-of-body experience. Illustration courtesy of Barrow Neurological Institute.*

Pam's near-death experience began to unfold. She relates the story with remarkable detail:

> The next thing I recall was the sound: It was a natural D. As I listened to the sound, I felt it was pulling me out of the top of my head. The further out of my body I got, the more clear the tone became. I had the impression it was like a road, a frequency that you go on…. I

> remember seeing several things in the operating room when I was looking down. It was the most aware that I think that I have ever been in my entire life…. I was metaphorically sitting on Dr. Spetzler's shoulder. It was not like normal vision. It was brighter and more focused and clearer than normal vision…. There was so much in the operating room that I didn't recognize, and so many people.
>
> I thought the way they had my head shaved was very peculiar. I expected them to take all of the hair, but they did not….
>
> The saw thing that I hated the sound of looked like an electric toothbrush and it had a dent in it, a groove at the top where the saw appeared to go into the handle, but it didn't…. And the saw had interchangeable blades, too, but these blades were in what looked like a socket wrench case…. I heard the saw crank up. I didn't see them use it on my head, but I think I heard it being used on something. It was humming at a relatively high pitch and then all of a sudden it went *Brrrrrrrrrr!* like that.

Spetzler removed the bone flap from Pam's skull, exposing the outermost membrane of her brain—the dura mater. This tough, fibrous covering was opened with special dural scissors. The operating microscope was then draped and swung into position. The remainder of the intracranial portion of the procedure took place under this microscope controlled by a lever held in Spetzler's mouth.

While Spetzler was opening Pam's head, a female cardiac surgeon located the femoral artery and vein in Pam's right groin. These vessels turned out to be too small to handle the large flow of blood needed to feed the cardiopulmonary bypass machine. Thus, the left femoral artery and vein were prepared for use. Pam later recalled this point in the surgery:

> Someone said something about my veins and arteries being very small. I believe it was a female voice and that it was Dr. Murray, but I'm not sure. She was the cardiologist *[sic]*. I remember thinking that I should have told her about that…. I remember the heart-lung machine. I didn't like the respirator…. I remember a lot of tools and instruments that I did not readily recognize.

Attention then shifted to large color television monitors mounted on the OR walls, which began to televise Pam's brain as seen through the operating microscope. The OR team followed Spetzler on the TV screen as he journeyed underneath the base of the temporal lobe, around the vein of Labbe, between the third and fourth cranial nerves, and to the neck of a giant basilar artery aneurysm. As feared, the aneurysm turned out to be, as Spetzler noted in his medical records, "extremely large and extended up into the brain." Hypothermic cardiac arrest would definitely be needed.

Into the Valley of the Shadow of Death

At 10:50 A.M. the cardiac surgeon and heart-pump technicians leapt into action. Tubes were inserted into the exposed femoral arteries and veins and connected to clear plastic hoses leading to and from the cardiopulmonary bypass machine. Warm blood from Pam's body began coursing through the hoses into the large reservoir cylinders of the bypass machine. Here it would be chilled before being returned to her body. The risky cooling process had begun.

At 11:00 A.M. Pam's core body temperature had fallen 25 degrees. The methodical beep-beep-beep of the cardiac monitor was interrupted by a steady warning tone indicating cardiac malfunction. The irregular, disorganized pattern of ventricular fibrillation now marched across the monitor screen. Five minutes later, the remaining electrical spasms of Pam's dying heart were extinguished with massive intravenous doses of potassium chloride. Cardiac arrest was complete.

As Pam's heart arrested, her brain waves flattened into complete electrocerebral silence. Brain-stem function weakened as the clicks from the ear speakers produced lower and lower spikes on the monitoring electrogram.

Twenty minutes later, her core body temperature had fallen another 13 degrees to a tomblike 60 degrees Fahrenheit. The clicks from her ear speakers no longer elicited a response. Total brain shutdown.

Then, at precisely 11:25 A.M., Pam was subjected to one of the most daring and remarkable surgical maneuvers ever performed in an operating room. The head of the operating table was tilted up, the cardiopulmonary bypass machine was turned off, and the blood was drained from Pam's body like oil from a car. Sometime during this period, Pam's near-death experience progressed:

> There was a sensation like being pulled, but not against your will. I was going on my own accord because I wanted to go. I have different

metaphors to try to explain this. It was like the Wizard of Oz—being taken up in a tornado vortex, only you're not spinning around like you've got vertigo. You're very focused and you have a place to go. The feeling was like going up in an elevator real fast. And there was a sensation, but it wasn't a bodily, physical sensation. It was like a tunnel but it wasn't a tunnel.

At some point very early in the tunnel vortex I became aware of my grandmother calling me. But I didn't hear her call me with my ears…. It was a clearer hearing than with my ears. I trust that sense more than I trust my own ears. The feeling was that she wanted me to come to her, so I continued with no fear down the shaft. It's a dark shaft that I went through, and at the very end there was this very little tiny pinpoint of light that kept getting bigger and bigger and bigger.

The light was incredibly bright, like sitting in the middle of a lightbulb. It was so bright that I put my hands in front of my face fully expecting to see them and I could not. But I knew they were there. Not from a sense of touch. Again, it's terribly hard to explain, but I knew they were there….

I noticed that as I began to discern different figures in the light—and they were all covered with light, they *were* light, and had light permeating all around them—they began to form shapes I could recognize and understand. I could see that one of them was my grandmother. I don't know if it was reality or projection, but I would know my grandmother, the sound of her, anytime, anywhere.

Everyone I saw, looking back on it, fit perfectly into my understanding of what that person looked like at their best during their lives.

I recognized a lot of people. My uncle Gene was there. So was my great-great-Aunt Maggie, who was really a cousin. On Papa's side of the family, my grandfather was there…. They were specifically taking care of me, looking after me.

They would not permit me to go further…. It was communicated to me—that's the best way I know how to say it, because they didn't speak like I'm speaking—that if I went all the way into the light something would happen to me physically. They would be unable to put this me back into the body me, like I had gone too far and they

> couldn’t reconnect. So they wouldn’t let me go anywhere or do anything.
>
> I wanted to go into the light, but I also wanted to come back. I had children to be reared. It was like watching a movie on fast-forward on your VCR: You get the general idea, but the individual freeze-frames are not slow enough to get detail.

With the blood drained from her body, the aneurysm sac collapsed like a deflated balloon. Spetzler clipped the neck of the aneurysm at its point of attachment to the basilar artery and excised the empty sac. The cardiopulmonary bypass machine was then turned back on and warmed blood began to be reinfused into Pam’s empty body.

Shortly after the warming had begun, the clicks from the speakers in Pam’s ears registered the first signs of life with telltale blips on the electrogram. Reassuring waves of electrical activity from her higher brain centers began again to advance across the EEG screen. Pam’s body appeared to be waking up, perhaps at a time during her near-death experience when she was being strengthened:

> Then they [deceased relatives] were feeding me. They were not doing this through my mouth, like with food, but they were nourishing me with something. The only way I know how to put it is something sparkly. Sparkles is the image that I get. I definitely recall the sensation of being nurtured and being fed and being made strong. I know it sounds funny, because obviously it wasn’t a physical thing, but inside the experience I felt physically strong, ready for whatever.

Then, at 12:00 noon, a serious problem arose. The initially silent heart monitor began to register the disorganized electrical activity of ventricular fibrillation. Efforts to correct this lethal cardiac rhythm with additional warming were unsuccessful. If left uncorrected, Pam would die on the table within minutes.

The cardiac surgeon quickly placed the two defibrillator paddles on Pam’s chest and shocked her heart with 50 joules of electricity. No response. The defibrillator was then charged with 100 joules and reapplied. After this second jolt of electricity, the familiar beep-beep-beep of normal

sinus rhythm brought forth sighs of relief from the cardiac surgical team, who were preparing to cut open her chest to revive her heart.

And Pam began her “return” from her near-death experience:

> My grandmother didn’t take me back through the tunnel, or even send me back or ask me to go. She just looked up at me. I expected to go with her, but it was communicated to me that she just didn’t think she would do that. My uncle said he would do it. He’s the one who took me back through the end of the tunnel. Everything was fine. I did want to go.
>
> But then I got to the end of it and saw the thing, my body. I didn’t want to get into it…. It looked terrible, like a train wreck. It looked like what it was: dead. I believe it was covered. It scared me and I didn’t want to look at it.
>
> It was communicated to me that it was like jumping into a swimming pool. No problem, just jump right into the swimming pool. I didn’t want to, but I guess I was late or something because he [the uncle] pushed me. I felt a definite repelling and at the same time a pulling from the body. The body was pulling and the tunnel was pushing…. It was like diving into a pool of ice water…. It hurt!

With additional warming and reinfusion of blood, the cardiopulmonary bypass machine was turned off at 12:32 P.M., when Pam’s temperature had reached a life-sustaining but still subnormal 89.6 degrees. Her body was then deinstrumented and her surgical wounds closed. The music in the background began playing rock as Spetzler’s younger assistants took over the closing surgical duties. The songs did not escape Pam’s notice:

> When I came back, they were playing “Hotel California” and the line was “You can check out anytime you like, but you can never leave.” I mentioned [later] to Dr. Brown that that was incredibly insensitive and he told me that I needed to sleep more. [laughter] When I regained consciousness, I was still on the respirator.

Spetzler’s surgical report indicates that at 2:10 P.M. the “patient was taken to the recovery room still intubated, but in stable condition.”

Reconsidering Death and the “Near-Death” Experience

Ever since my earliest research into the near-death experience in the 1970s, I have consistently maintained that these are *near-death,* not *after-death* experiences. In *Recollections of Death,* I found that the closer one came to death, the more likely one would later report a near-death experience. That is, patients who had been hospitalized at the time of their near-death crisis events, who had been unconscious for longer periods of time, and who had required medical resuscitation for survival, were much more likely to report NDEs than those surviving out-of-hospital events associated with briefer periods of unconsciousness and unassisted resuscitation.

Being close to death, *no matter how close,* was still a far cry from being dead.

Then Pam’s story jostled my certainty. When I first read her operative report at her mother’s home in November 1994, I was incredulous. Who, in their right mind, would eliminate all of a person’s vital signs, chill her body to 60 degrees, drain her blood, and still expect her to live? I *really* could not believe it! So I phoned the Barrow Neurological Institute and had them fax me *their* copy of Spetzler’s report along with the operative summaries of the neuroanesthesiologist and cardiac surgeon.

Much to my surprise, I found the surgical details of Pam’s story corroborated. Had her surgeons brought her back from the dead? Based on old definitions of death they had done just that.

The scientific definition of death is a medical quagmire. Previously, death was declared when a person was found unconscious without pulse or respiration. Death was confirmed by holding a mirror under the nose to test for condensation and by checking the pupils for a reaction to light. In the mid-nineteenth century, the invention of the stethoscope enabled doctors to diagnose death by the absence of heart sounds. The electrocardiogram made

this diagnosis more secure by recording loss of electrical activity in the heart.

This so-called heart-lung criteria of death fell out of favor, however, with the advent of cardiopulmonary resuscitation (CPR), which enabled persons pronounced “dead”—without heartbeat and respiration—to be brought back to life. This necessitated a new definition of death: the loss of *brain* function. The brain is a complicated organ with markedly different divisions of structure and function: the cerebrum or “higher brain” controls consciousness, thought, feeling, and memory; the brain stem or “lower brain” controls the involuntary functions of respiration, yawning, and sleep-wake cycles; and the cerebellum controls balance and coordination. Initially, this diversity of brain function was not a problem in defining death since, according to the Uniform Determination of Death Act formulated by a special presidential commission in 1981, this diagnosis required the “cessation of all functions of the entire brain.” This became known as the “whole brain” definition of death.

During CPR, however, the cerebrum was found to be more vulnerable to brief periods of absent blood flow and oxygen than was the brain stem. This set up the possibility that the “lower brain” could be saved after “higher brain” functions had been irreversibily lost—a condition known as the “persistent vegetative state.” Such persons remain comatose, lose all awareness of self and environment, but maintain respiration and other “lower brain” functions. Loss of “higher brain” activity was then proposed as yet another definition of death to account for this situation which, to many, equalled death. Debate still rages, signaling the arbitrariness of deciding whether the “whole brain” or “higher brain” definition or neither of these two definitions of death is scientifically accurate.

Nonetheless, for practical purposes outside the world of academic debate, three clinical tests commonly determine brain death. First, a standard electroencephalogram, or EEG, measures brain-wave activity. A “flat” EEG denotes nonfunction of the cerebral cortex—the outer shell of the cerebrum. Second, auditory evoked potentials, similar to those elicited by the ear speakers in Pam’s surgery, measure brain-stem viability. Absence of these potentials indicates nonfunction of the brain stem. And third, documentation of no blood flow to the brain is a marker for a generalized absence of brain function.

But during “standstill,” Pam’s brain was found “dead” by all three clinical tests—her electroencephalogram was silent, her brain-stem response was absent, and no blood flowed through her brain. Interestingly, while in this state, she encountered the “deepest” near-death experience of all Atlanta Study participants. The average score for an NDE on Dr. Greyson’s NDE Scale was 15, similar to the 13.3 average I found in The Atlanta Study. Pam’s NDE stood out, however, with an amazing depth of 27!

With this information, can we now scientifically assert that Pam was either dead or alive during her near-death experience? Unfortunately, no. Even if all medical tests certify her death, we would still have to wait to see if life was restored. Since she did live, then *by definition* she was *never* dead. Doctors can save people from death and rescue some who are close to death, but they cannot raise people from the dead. Conversely, if Pam had died, the tests indicating death would have been confirmed.

On CBS’ *48 Hours*, Dr. Spetzler was interviewed along with Pam and myself. As Pam’s attending surgeon, he emphasized that during hypothermic cardiac arrest, “If you would examine that patient from a clinical perspective during that hour, that patient by all definition would be dead. At this point there is no brain activity, no blood going through the brain. Nothing, nothing, nothing.”

When asked about Pam’s near-death experience, the surgeon delicately avoided the question: “One thing that I learned after spending so many years of dealing with the brain is that nothing is impossible.”

Dr. Linda Emanuel, in the probing article “Reexamining Death,” writes:

> The reigning view [of death] has assumed that life and death are nonoverlapping, dichotomous states. This view acknowledges that dying may take time, but presumes that a threshold event is nevertheless definable; a person is thought to be either alive or dead, not both…. Is there an event that can identify final and complete loss of life? The answer appears to be no…. The process of dying occurs at different levels of organization, from the organism to the organ, cellular, and subcellular levels, and each set of systems can decline on a somewhat independent trajectory.[3]

Several scientific observations support Emanuel's argument that loss of biologic life, including death of the brain, is a process and does not occur at a single, definite moment. Physicians at Loyola University Medical Center found that 20% of patients had persisting EEG activity up to seven days after extensive testing had otherwise diagnosed brain death.[4] Normal function of the pituitary gland (a part of the brain lying at the base of the skull) has been found several days after the diagnosis of brain death in patients.[5] And startling records of 10 organ donors diagnosed "brain-dead" showed an average increase in blood pressure of 31 millimeters of mercury and in heart rate of 23 beats per minute in response to surgical removal of the organs—reactions inconsistent with total cessation of brain function.[6] These findings indicate that even when a person is deemed "brain dead" by strict clinical criteria—that is, showing no spontaneous movements or respiration; no response to painful or auditory stimulation; and no brain stem, cough, gag, or respiratory reflexes—brain activity can often still be demonstrated days later, raising the question of *when*, if at all, death had actually occurred.

Thus, the problem with defining the moment of death lies not in our lack of sufficient scientific tools, but in the concept itself. There *is* no definable moment of death, but only a process of dying which starts with life and eventually ends in death. The journey through a near-death experience may best be understood as an experiential counterpart to this physical dying process. And whether this journey ends in life or in death is determined not only by the physical factors at play, but, as we shall see next, by events unseen by all except the unconscious, dying patient.

The practice of medicine … is an art, based to an increasing extent on the medical sciences but comprising much that still remains outside the realm of any science.[1]

—Francis W.Peabody, M.D.
"The Care of the Patient"
The Journal of the American Medical Association, 1927